



COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA) PROJECT

Cartridge, 40MM, HEDP, M433 Polysulfide Rubber Adhesive Replacement

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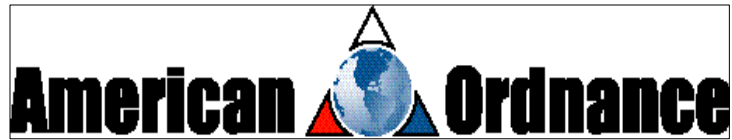
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CRADA PROJECT METHODOLOGY

American Ordnance, LLC, Milan has a highly trained staff in both Six Sigma and Lean Manufacturing methodologies. Using these methodologies has resulted in a culture focused on continuous improvements. The M433 Polysulfide Rubber Adhesive Replacement Project is one of many such projects underway at AO Milan.



CRADA PROJECT OVERVIEW

- **Product & Field Application**
- **Improvement Concept**
- **Improvement Impact**
- **Improvement Design**
- **Implementation Plan**
 - **Product Qualification**
 - **Full Scale Production**
- **Project Result Goals**
 - **Improved Manufacturability**
 - **Improved Product Reliability**
- **Project Milestones**
- **Project Summary**

Product and Field Application

- **Product**
 - 40MM, HEDP, M433
 - Low Velocity
 - Shoulder Fired
- **Field Application**
 - M203 Launcher
- **Used By All Branches Of The Services**



Improvement Concept

Problem:

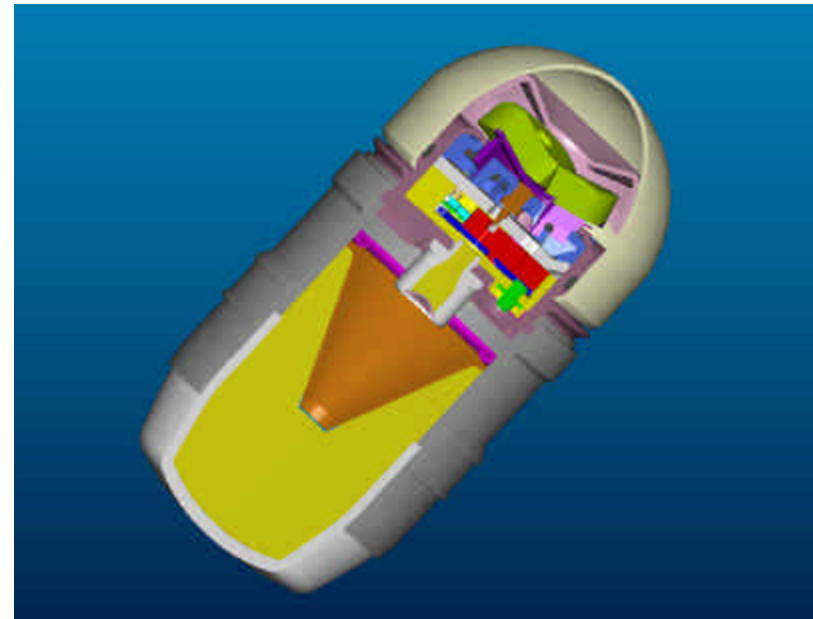
Currently Polysulfide Rubber Seals Case to Projectile

- **Difficult and Costly to Assemble Cartridge**
- **US Suppliers no longer in production**

Objective:

Replace with Mechanical Seal

- **O-Ring**
- **Crimp**





Improvement Impact

- **Replacing Polyfulfide Rubber, not Available Except Off Shore, with O-rings, available with Competitive Pricing**
- **Improve Productivity**
 - **Reduce Takt Time**
 - **Eliminate Polysulfide Rubber Laboratory Preparation**
 - **Eliminate Material Handling**
 - **Eliminate Assembly Operations**
- **Improve Robustness of & Reduce Variation in the Manufacturing Process**
 - **Mistake Proof Case to Projectile Assembly**
 - **Relocation of Crimp**
 - **Elimination of Heat Bay**
 - **Reduce Variation in Bullet Pull results**



Process Operations Before and After

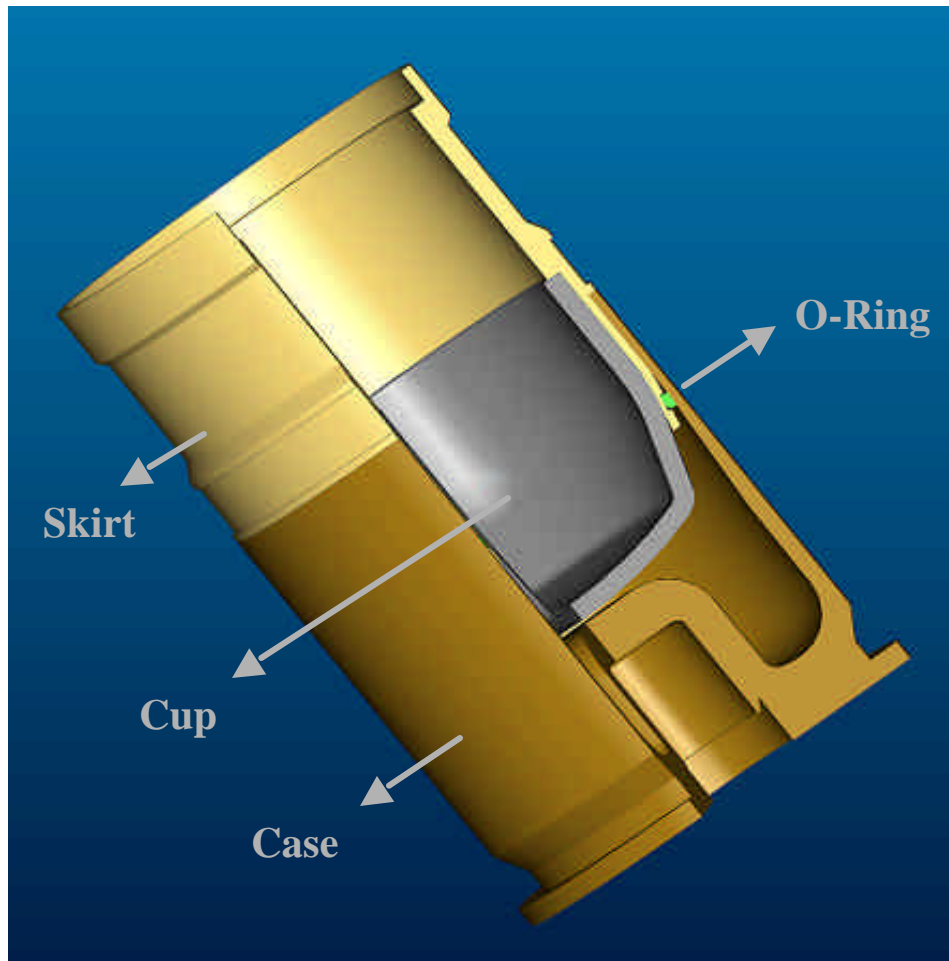
Process with Polysulfide Rubber

- ✓ Apply Polysulfide Rubber
- ✓ Assemble Case to Projectile with Vacuum
- ✓ Stake Case to Projectile
- ✓ Pack Fuze Down
- ✓ Transport to Heat Bay
- ✓ Condition 5 Hours @ 100 degrees F
- ✓ Transport to Assemble Line
- ✓ Remove Exuded/Cured Polysulfide Rubber
- ✓ Chamber Gage

Process with O-Ring

- ✓ Apply O-Ring
- ✓ Assemble Case to Projectile
- ✓ Rubber Die Crimp Case to Projectile
- ✓ Stake Case to Projectile
- ✓ Chamber Gage

Improvement Design



- **Add Length to Skirt**
 - Does not jeopardize integrity of cup/skirt bond
- **Square Ring**
 - Shallow Groove
 - Assembly Friendly
- **Rubber Die Crimp**
 - 25% Compression



Implementation Plan

- **Product Qualification**
 - **Performance to Specification**
 - **Cartridge Ballistic Performance Verification**
 - **Continuous Sampling Will Be In Place During LAP**
 - **Budget**
 - **Reduced Labor**
 - **Reduced Material Cost**
 - **Reduced Utility Cost**
 - **Schedule**
 - **Polysulfide Rubber Purchasing Problem Eliminated**
 - **O-rings Readily Available**
 - **Process Modifications Short Term**



Improvement Plan

- **Full Scale Production**
 - **Improvements Will be Continuously Measured**
 - **Continuous Sampling During LAP**
 - **Ballistic Performance Tested on Each Lot**
 - **Design Change Mistakes Proofs Much of Process**
 - **Control**
 - **Statistical Process Control Applied to Quantify Improvements**
 - **Statistical Process Control Will Identify Abnormal Changes in Process**



Project Result Goals

- **Improved Manufacturability**
 - **Steps to Achieve Goals**
 - **Eliminates Processing in Laboratory**
 - **Eliminates Blending of Accelerator**
 - **Eliminates Application Equipment Clean-up**
 - **Eliminates Removal of Exuded/Cured Adhesive From Cartridges**
 - **Assembly With O-ring**
 - **Process Cycle Time Reduction - 500%**
 - **Adhesive/O-Ring Material Cost Reduced - 44%**
 - **Assembly Labor Hours Reduced - 36%**
 - **Virtually Mistakes Proofs a Major Portion of Process**
 - **Total Unit Cost Reduced - 3%**
 - **Improve Availability and Lead Time on Components**
 - **Decrease Production Downtime by 15%**

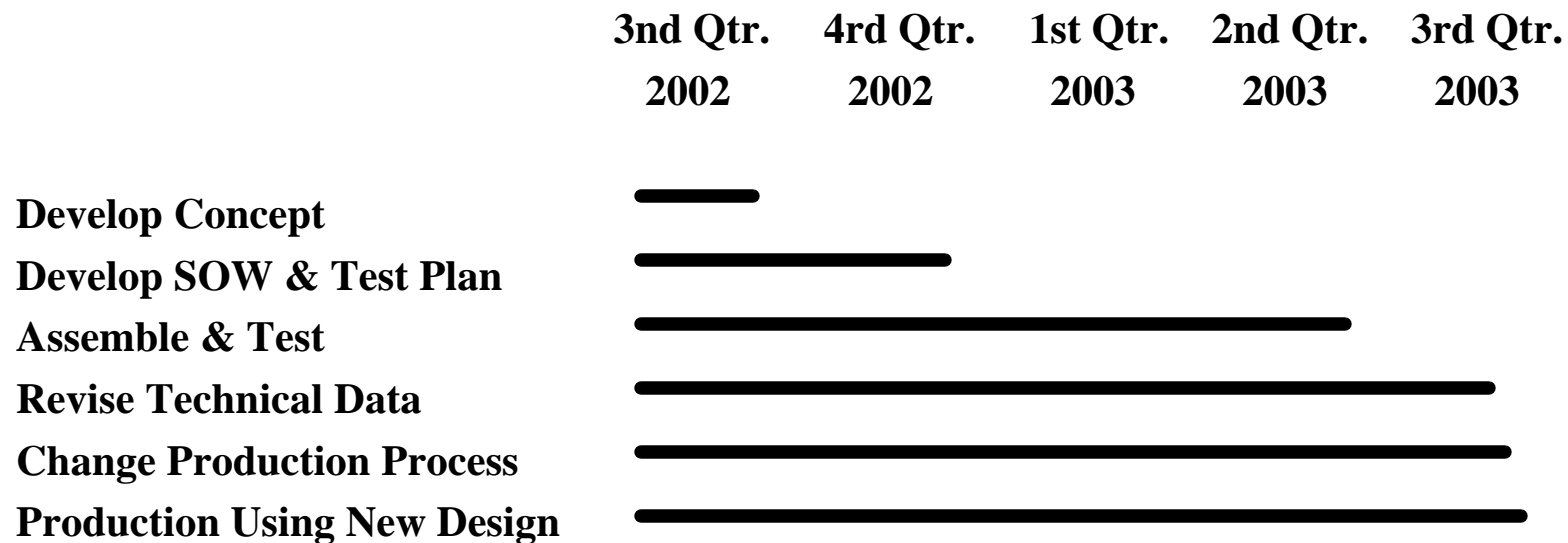


Project Result Goals

- **Improved Product Reliability**
 - **Ballistic Performance, Standard Deviation, Improved - 10%**
 - **Cartridge Seal Reliability Up**
 - **Improved Ability to Store in Extreme Environments**
 - **Improved Seal Deterioration Eliminated for Long Term Storage**



Project Milestones





Project Summary

- **Product Quality Level Increased**
- **Reduced Cost, Labor & Materials**
- **Quality Up/Cost Down = Satisfied Customer**
- **Thanks To ARDEC And American Ordnance Management For The Continued Project Support**